

Actigraphy Monitoring of Sleep Disturbance and Physical Activity in Adults with Depressive Symptoms

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Introduction

- Sleep disturbance is often a primary predecessor and indicator of psychopathology such as Major Depressive Disorder (MDD)¹⁻³.
- Similarly, it is strongly associated with increased MDD symptomatology, specifically rumination, a form of negative self-referential processing^{4-6,8-9}.
- Comparatively, increased physical activity (PA) decreases depressive symptoms, particularly rumination⁷.
- The current study explored the utility of actigraphy for objectively measuring changes in sleep and activity levels, thereby monitoring depressive symptoms like rumination.
- As an index of sleep fragmentation, sleep efficiency (SE) was examined to better capture sleep quality than total sleep time alone.
- Objective and efficient methods to measure SE and PA are needed to better assess, treat, and track outcomes of MDD symptoms.

Methods

Participants

- 149 adults, fluent English speakers of Caucasian descent (mean age = 23.26, SD = 4.84).
- Community sample recruited on a continuum of depressive symptoms.

Initial Questionnaires

- During initial meeting, subjects completed mood and emotional processing related surveys including the Ruminative Response Scale (RRS), Perseverative Thinking Questionnaire (PTQ), and the Beck Depression Inventory (BDI-II).
- Subjects also completed the The self-referential encoding task (SRET), an implicit measure of self-schema.



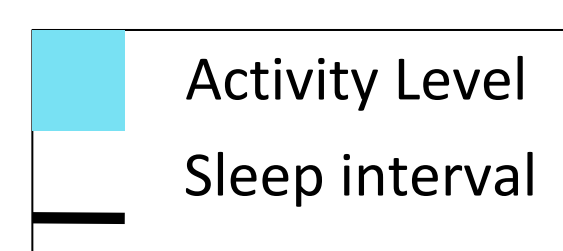
Subjects wore Actiwatches & completed daily questionnaires for one week of standard daily activities.

Actigraphy

- During the first session, subjects received wrist worn accelerometers (Philips Actiwatch 2) which were worn for 7 days continuously.
- Subjects reported factors related to their sleep patterns in daily questionnaires.
- Actigraphy data was processed and reported with Philips Actiware Software.



Figure 1. Sample actigraphy plot. Increased activity within the calculated sleep interval results in a lower calculated SE.



Efficiency Scoring

- Daily SE calculated from sleep intervals. Equals: nocturnal sleep time / total rest interval time. Overall SE is mean of each daily SE.

Physical Activity Scoring

- Daily PA calculated from awake intervals. Equals: total activity counts / total awake interval time. Overall PA is mean of each daily PA.

Results

- Mean days wearing watch was 7.42 days (mean = 7.42, sd = 1.88).
 - Mean sleep efficiency was 0.869 or 86.9% (mean = 0.869, sd = 0.071) (Fig. 1).
 - Mean physical activity was 271049.7 (mean = 271049.7, sd = 84854.21) (Fig. 2).
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- No significant relationship between PTQ score and sleep efficiency.
 - In a linear mixed model with PTQ and BDI score (categorical) as predictors, PTQ was a significant predictor of sleep efficiency, $t(1, 145) = 2.252$, $p = 0.0258$ (Fig. 3).
 - Significant interaction between PTQ and BDI score in predicting sleep efficiency, $F(1, 145) = 2.647$, $p = 0.05$ (Fig. 3).
 - Stronger relationship between PTQ Score and sleep efficiency in individuals with depression (BDI > 20).
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- Negative relationship between RRS Brooding and sleep efficiency, $b = -0.0023$, $p = 0.008$.
 - In a linear mixed model with RRS Brooding and BDI Score (categorical) as predictors, RRS Brooding was no longer a significant predictor of sleep efficiency, $t(1,132) = 0.482$, $p = 0.63$. BDI as a categorical variable was significant, $t(1,132) = 2.259$, $p = 0.0255$ (Fig. 4).
 - Significant interaction between RRS Brooding and BDI Score in predicting sleep efficiency, $F(1, 132) = 3.502$, $p = 0.01735$.
 - Among people with high depression (BDI > 20), sleep efficiency decreases as rumination increases. Among people with low depression (BDI < 20), there was no notable association between rumination and sleep efficiency.

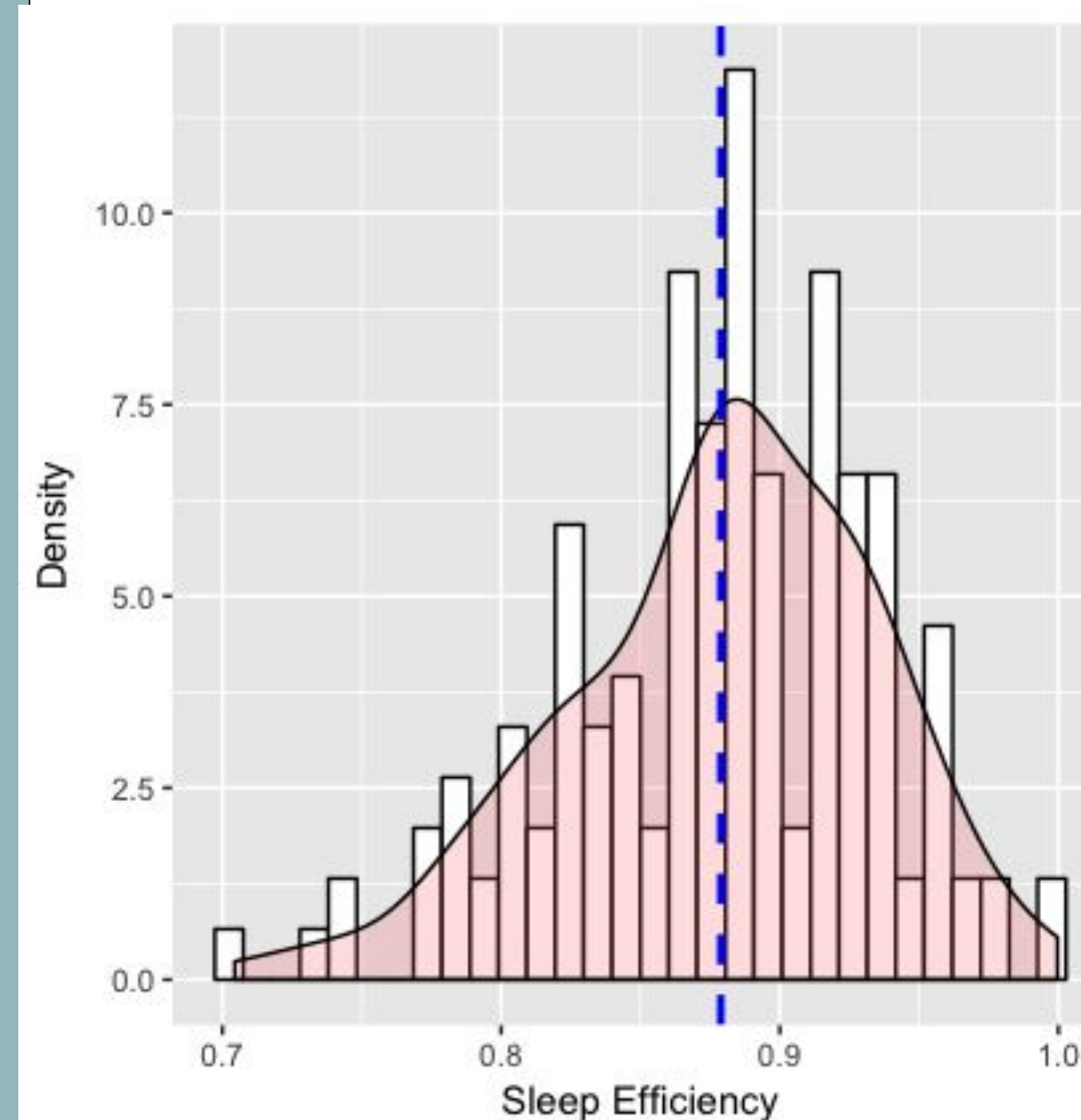


Figure 1. Distribution of sleep efficiency scores.

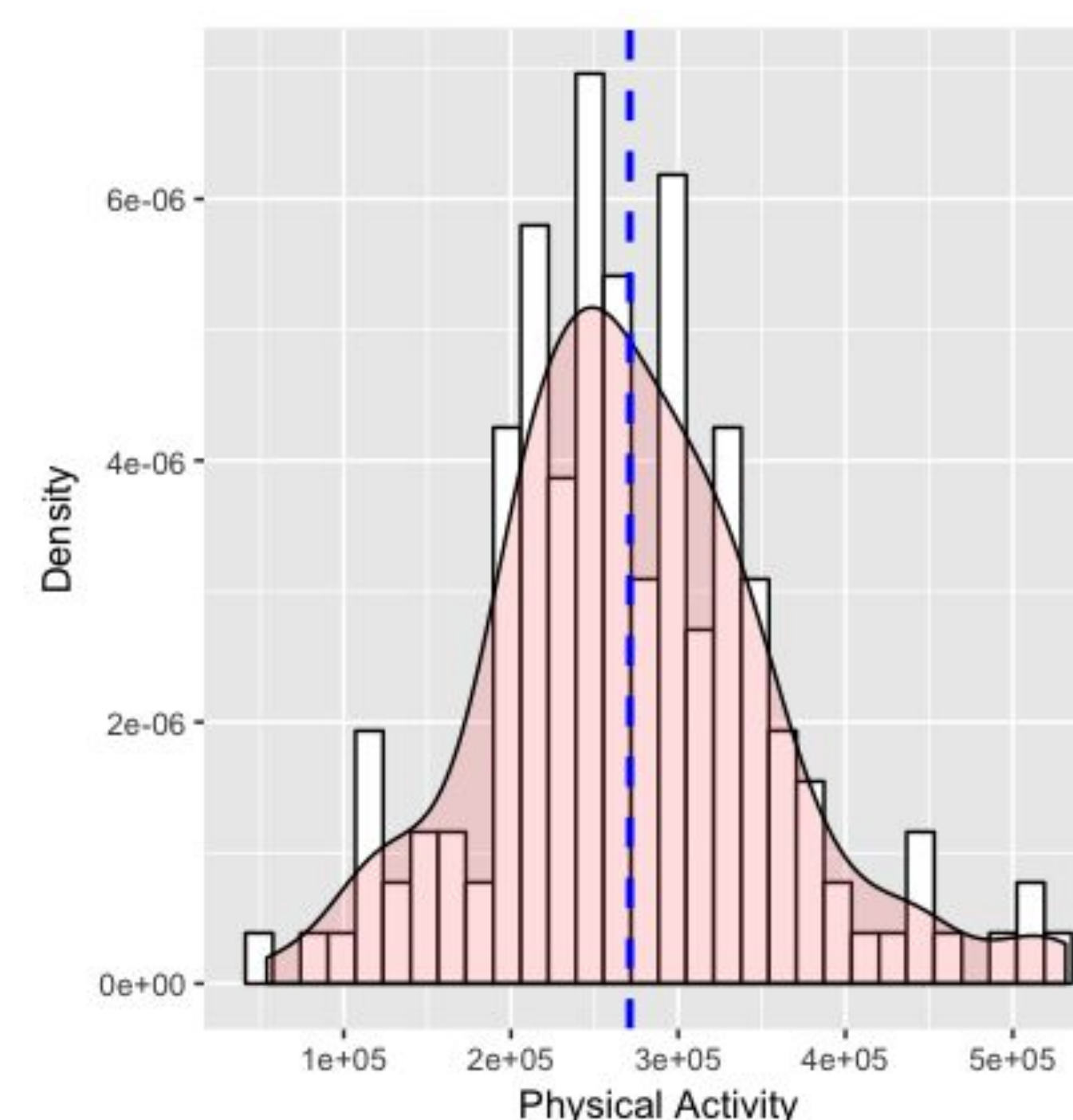


Figure 2. Distribution of physical activity scores.

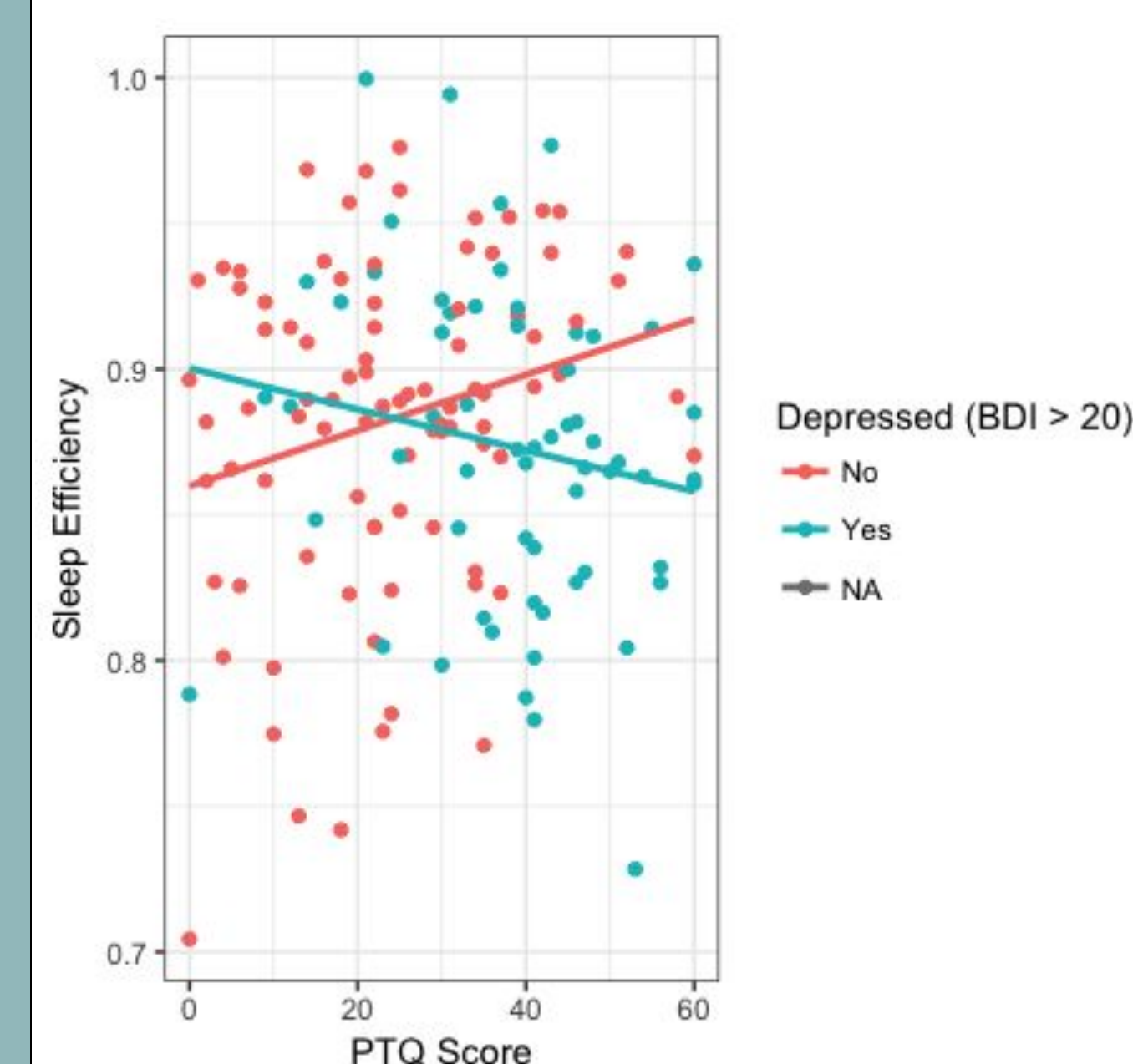


Figure 3. Sleep efficiency by PTQ Score and BDI.

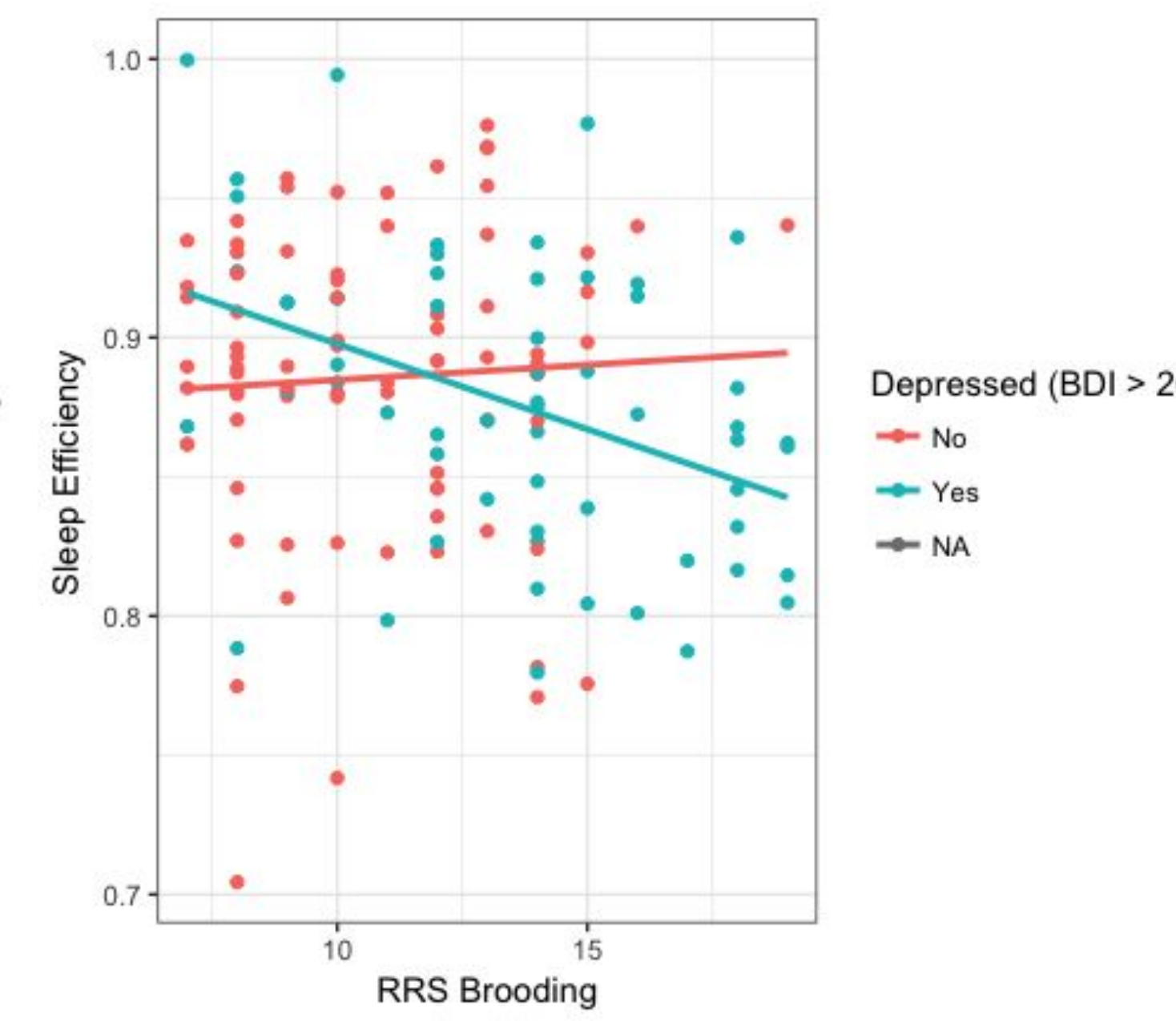


Figure 4. Sleep efficiency by RRS Brooding Score and BDI.

Results

- Negative relationship between BDI Total and Physical Activity ($b = -1684.3$, $p = 0.004358$) (Figure 5).
- Negative relationship between PTQ Total and Physical Activity ($b = -908.2$, $p = 0.04071$) (Figure 6).
- Negative relationship between SRET number of negative words endorsed and physical activity ($b = -3304$, $p = 0.0032$) (Figure 7).
- Positive relationship between SRET number of positive endorsed and physical activity ($b = 2279.2$, $p = 0.011$) (Figure 8).

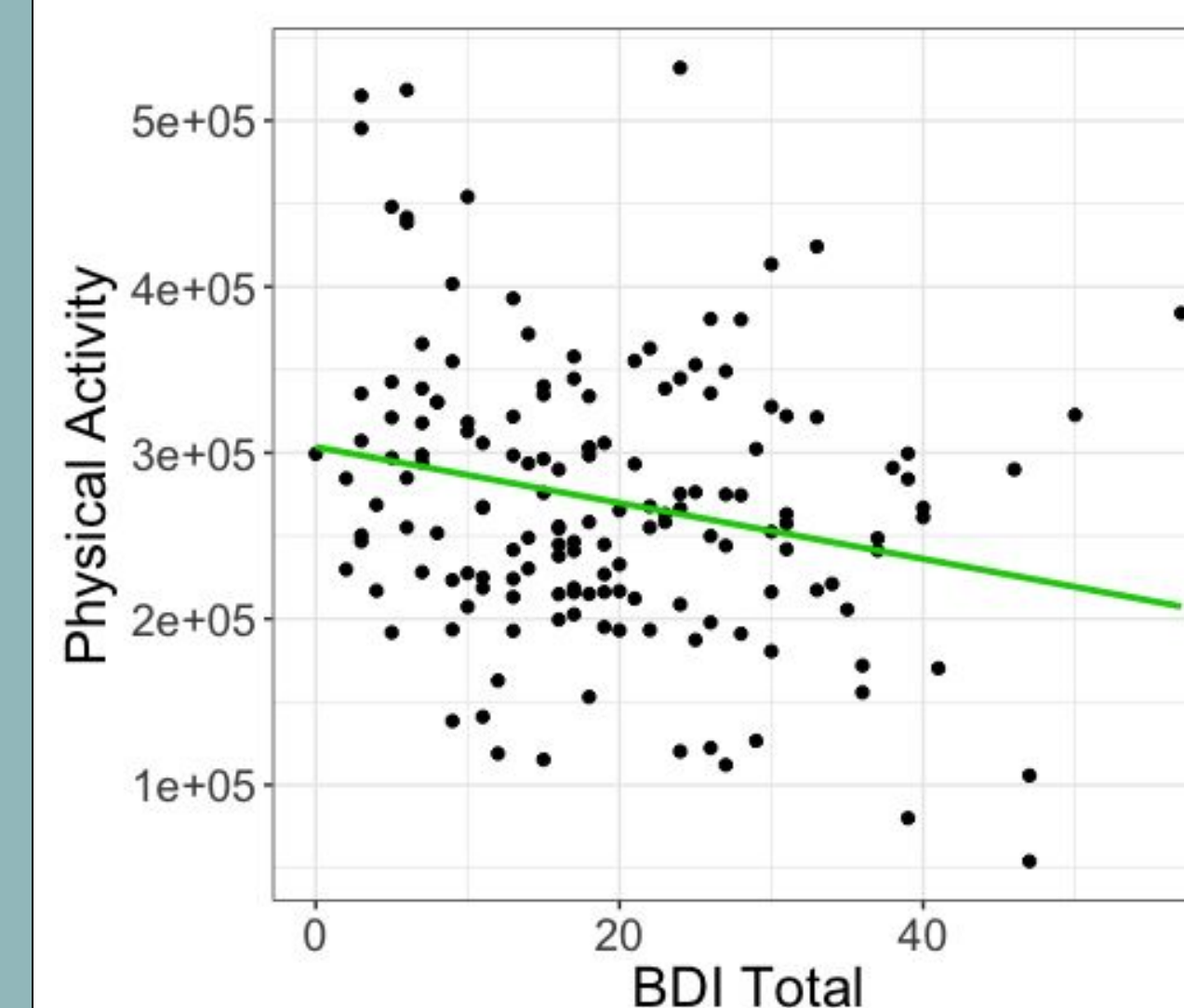


Figure 5. Physical Activity by BDI Scores.

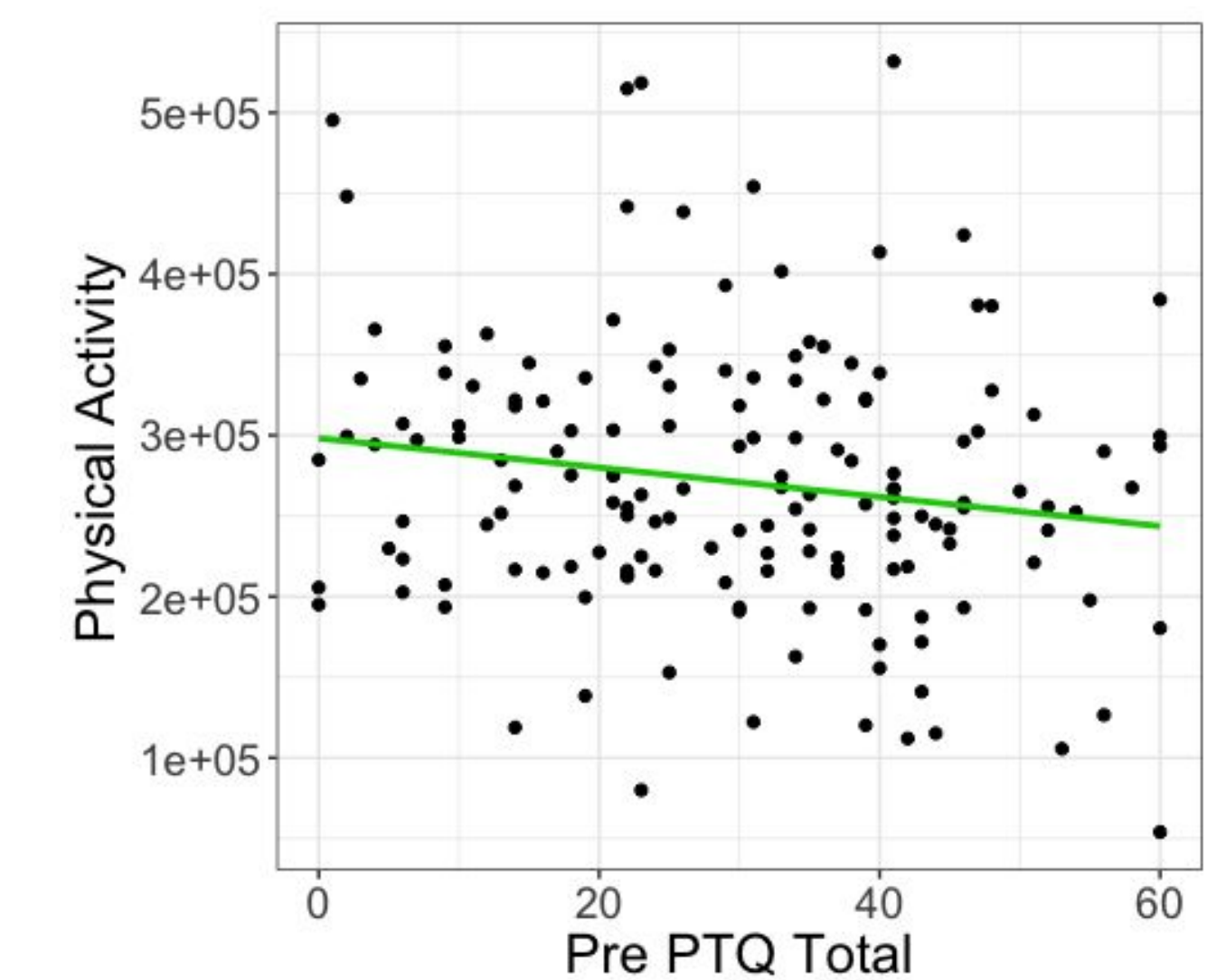


Figure 6. Physical Activity by PTQ Total.

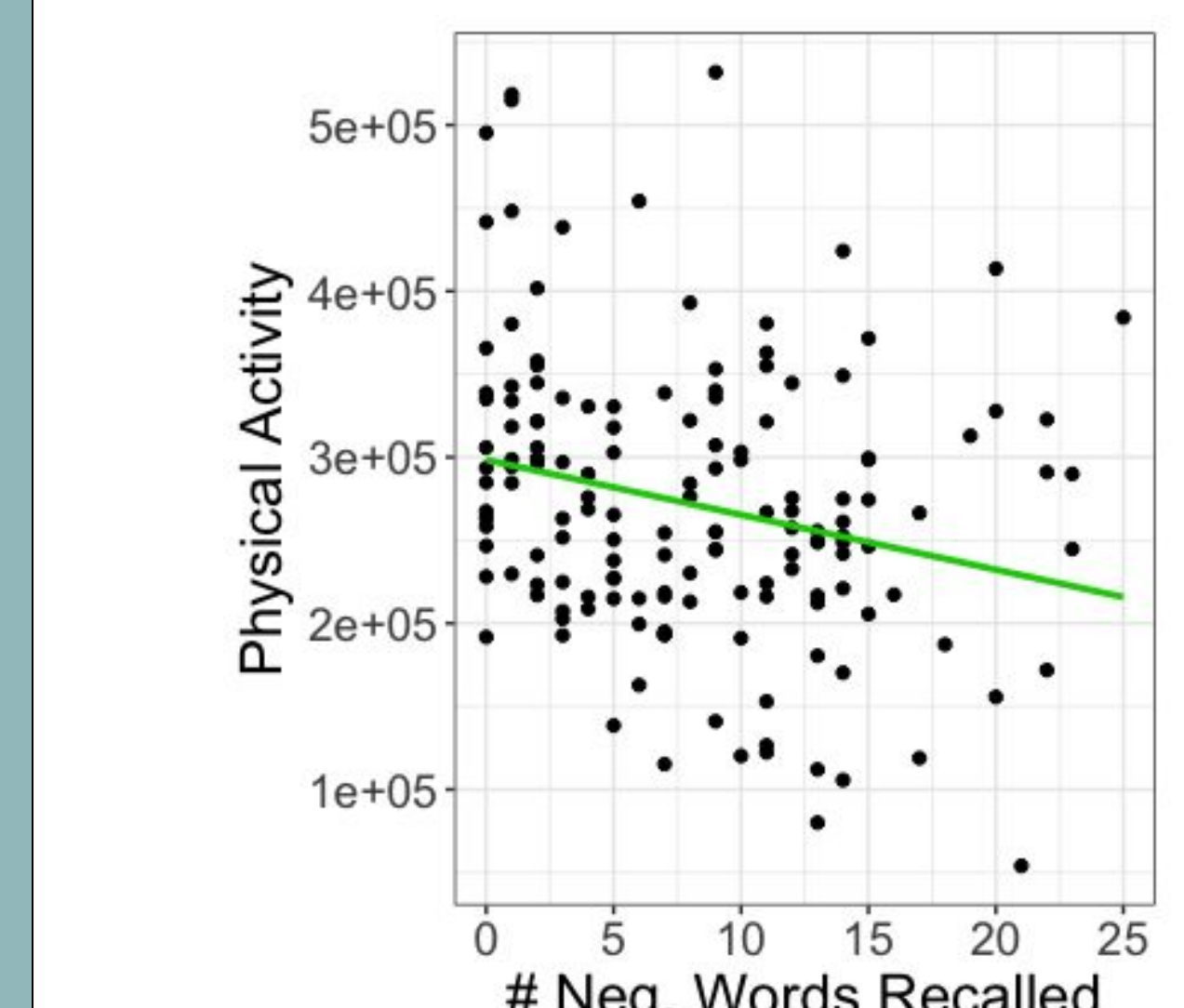


Figure 7. Physical activity by SRET number of negative words endorsed.

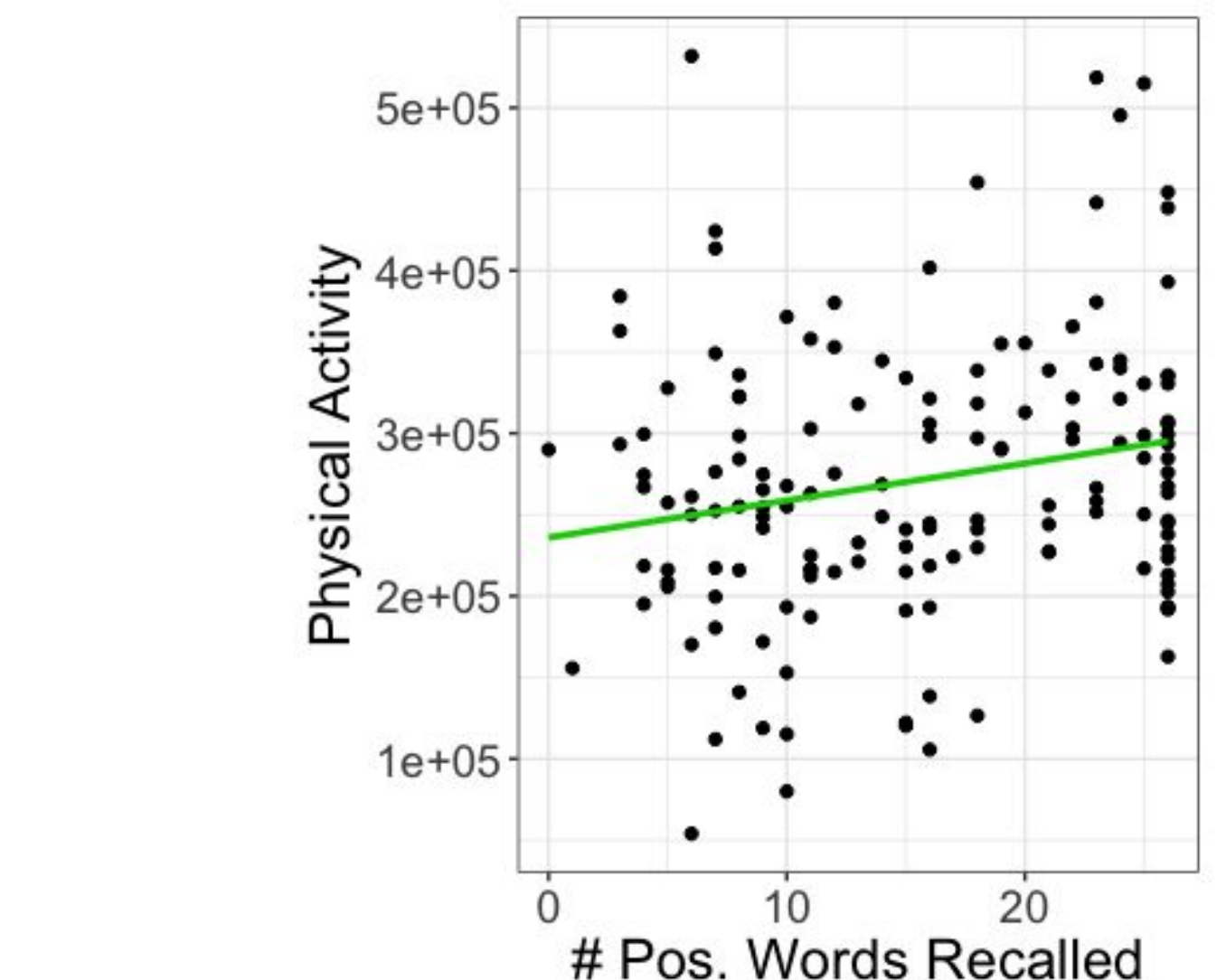


Figure 8. Physical activity by SRET number of positive words endorsed.

Discussion

- Findings suggest that individuals with more depressive symptoms experience a decreased quality of sleep, specifically SE, decreased PA, and an increase in ruminative brooding.
- As PA increased, negative emotional processing decreased, demonstrating an improvement in Elevated Depressive Symptoms (EDS).
- Additionally, decreased SE is indicative of ruminative brooding in the EDS group.
- These results demonstrate the utility of actigraphy for accurately measuring sleep and physical activity objectively in a naturalistic setting, a critical feature which could benefit future research and treatment monitoring with MDD populations.
- Furthermore, the ability of actigraphy to identify poor SE and improved PA, on a continuum of depressive symptoms, indicates its potential for detecting early signs of changing symptoms in depressed populations.

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